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MUNICIPAL SEWAGE TREATMENT NEEDS

John R. Thoman, et al

Public Health Service
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U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Public Health Service

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**U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service**

**Bureau of State Services
Division of Sanitary Engineering Services
Water Supply and Water Pollution Control Program
Washington 25, D. C.**

MUNICIPAL
SEWAGE TREATMENT
NEEDS



This is a companion document to
PHS Publication No. 609 entitled
"Statistical Summary of Sewage
Works in the United States."

PUBLIC HEALTH SERVICE PUBLICATION NO. 619

1958

MUNICIPAL SEWAGE TREATMENT NEEDS

A general summary of data relating to sewer systems and sewage disposal in the United States was recently prepared by the Public Health Service (1). This summarization of physical facilities data was based on the 1957 Inventory of Sewage and Industrial Waste Facilities (2). The Inventory also contained information on reported needs both for present treatment plants and for systems discharging raw sewage. This report presents summarized information on these sewage disposal requirements.

Data Included

The Inventory forms requested specific information from the various State water pollution control agencies as to pollution abatement needs for each community or special district listed. Eight separate categories of needs were defined; the majority of these are mutually exclusive in their application.

These categories, and a brief explanation of each, are:

- 0—*New Treatment facilities:* A plant is needed where none now exists.
- 1—*Enlargement of existing facilities:* Expansion of present facilities and processes is required. The addition of new or different processes is precluded.
- 2—*Additions:* Addition of other treatment methods or processes is needed.
- 3—*Chlorination:* Self-explanatory.
- 4—*Replacement of existing plant:* The present plant is to be completely replaced and no longer used.
- 5—*Improved operation or utilization of existing facilities:* Self-explanatory.
- 6—*Connection to adequate existing sewer system:* Self-explanatory.
- 7—*No needs.*

In practice, it is often difficult, in the absence of detailed engineering study, to state whether an existing treatment facility needs replacement (code 4), or enlargement (code 1), or additions (code 2). The same difficulty exists in certain situations where connection to an adequate system (code 6) is as feasible a solution, apparently, as the construction of a new plant (code 0).

Accordingly, the reporting agencies have given multiple responses to the needs question in some instances. To make the tables in this report additive, it was necessary to arbitrarily select one alternative. In all cases, where such a procedure was necessary, the lower code number was selected. The number of such arbitrary selections was small, and have not significantly influenced the data presented.

TABLE 1. Reported needs for present sewage treatment plants

POPULATION SIZE	Total		Replacement of existing facilities		Enlargements		Additions		Chlorination		Improved operation		Connection to adequate sewers		None needed		No information	
	No. of plants	Estimated population served	No. of plants	Estimated population served	No. of plants	Estimated population served	No. of plants	Estimated population served	No. of plants	Estimated population served	No. of plants	Estimated population served	No. of plants	Estimated population served	No. of plants	Estimated population served	No. of plants	Estimated population served
POPULATION SIZE																		
Under 500	808	274,172	101	30,379	34	12,270	88	24,910	6	4,290	59	16,432	2	500	394	130,168	120	55,223
500-1,000	1,322	855,201	221	133,181	79	49,014	165	104,550	11	7,060	89	54,710	2	1,970	631	431,610	124	73,406
1,000-5,000	3,468	6,802,647	537	873,996	328	696,471	316	524,929	10	18,166	149	283,540	8	13,995	1,667	3,303,140	453	885,416
5,000-10,000	863	5,333,374	66	336,020	98	718,508	80	643,374	7	56,700	17	144,845	5	17,660	502	3,039,207	91	577,660
10,000-25,000	595	8,416,020	29	1,035,840	82	1,201,439	56	825,970	5	111,900	8	67,400			340	4,284,456	75	889,015
25,000-50,000	199	5,953,269	11	275,700	28	890,687	23	670,515	1	36,000	6	139,475			106	2,250,992	24	689,900
50,000-100,000	99	6,302,432	5	299,520	22	1,503,257	11	677,320			1	180,940	1	5,800	40	2,910,233	11	725,360
Over 100,000	164	62,306,616	3	117,000	20	10,244,390	14	4,215,780	1	364,000			3	16,450	100	23,347,796	23	4,901,300
STATES																		
Alabama	120	553,460	19	24,850	4	7,500	44	276,010			5	16,475			23	218,730	15	9,895
Arizona	82	477,712	18	43,390	3	2,660	13	18,635	2	12,000	13	38,894			30	357,283	3	4,850
Arkansas	119	360,885	31	75,905	23	60,050					1	390			44	135,600	29	11,133
California	450	10,251,109	25	202,740	16	4,610,278	27	376,215	1	2,000	10	229,367	1	400	27	1,263,583	27	3,538,111
Colorado	108	1,009,351	23	32,475	8	163,062	37	645,439	10	85,353		1,000			27	80,340	7	860
Connecticut	66	1,203,860	1	19,200	6	170,460	4	68,500			1	1,800	1	900	22	937,200	1	5,800
Delaware	9	169,570	1	50	1	800	3	13,180							4	135,540		
District of Columbia	1	1,240,000					1,240,000											
Florida	168	1,129,394	32	59,481	9	97,200	4	64,450			7	11,840	5	10,250	120	801,558	5	4,815
Georgia	165	800,430													2	11,400	163	789,030
Idaho	52	121,370	17	10,160	2	22,000	5	8,200			4	6,200			13	66,810	11	9,000
Illinois	381	7,115,041	28	59,065	48	415,031	17	268,005			1	50	1		27	6,325,000	10	6,325,000
Indiana	138	1,979,102	7	26,740	9	546,210	4	13,250			1	50	1	900	13	1,131,072	3	134,800
Iowa	352	944,790	74	53,145	36	453,526	36	46,970			30	23,265			155	336,412	1	372
Kansas	230	952,335	49	146,500	37	253,340	11	246,070			26	33,600	2	6,970	123	366,795	2	4,460
Kentucky	84	878,120	11	26,470	1	8,000	9	70,950			4	9,000	1	990	56	799,910	2	1,900
Louisiana	72	347,534	5	12,300	4	52,000	2	6,300							48	247,000	1	32,204
Maine	20	52,676	4	52,635	10	836,713	2	3,400			1	753			7	4,971	15	1,790
Maryland	82	1,095,120	4	3,000							6	7,983	1	8,500	22	135,815	4	33,130
Massachusetts	68	2,577,110	3	703,290	14	138,885	11	270,450							40	1,444,485		
Michigan	144	3,734,832	12	48,000	35	2,619,929	14	104,960	1	25,000	8	61,120			66	718,283	8	157,540
Minnesota	279	1,461,874	38	54,920	23	1,016,900	35	38,005	1	650	43	86,820			95	256,066	41	26,543
Mississippi	370	1,335,315	15	35,000	10	1,000,000	10	1,000,000							56	79,480	3	6,300
Missouri	270	580,015	25	98,195	34	115,634	25	55,005			14	13,665			127	294,471	11	4,135
Montana	82	149,035	26	30,665	10	22,460	4	37,200			6	13,710	1	160	36	44,840		

Nabesha.....	164	349,247	18	27,480	16	100,900	6	4,600	26	19,920	94	196,257	.....
New Hampshire.....	32	170,844	4	14,160	3	67,400	5	7,799	5	55,800	11	25,280	.....
New Jersey.....	15	52,400	.....	.....	.....	.....	.....	.....	.....	1,700	1	280	.....
New Mexico.....	224	3,933,308	21	234,240	13	52,620	11	1,337,740	1	100	144	1,928,853	32
New York.....	69	494,385	10	64,635	6	116,300	4	14,000	.....	.....	46	299,350	.....
North Carolina.....	306	8,934,500	11	131,400	50	697,284	24	979,404	1	350	200	6,660,187	13
North Dakota.....	116	2,774,510	51	66,695	49	185,350	47	104,601	62	141,973	36	359,471	11
Oklahoma.....	119	1,209,650	62	54,660	15	32,830	16	96,500	.....	.....	28	1,855,000	.....
Oregon.....	297	4,831,232	8	12,830	9	604,415	21	271,000	.....	.....	226	3,933,042	8
Pennsylvania.....	246	1,110,543	16	12,735	34	118,995	65	156,660	1	830	127	821,123	1
Rhode Island.....	117	763,080	11	12,700	4	15,350	4	10,250	3	5,000	92	340,180	1
South Carolina.....	290	4,278,966	1	5,000	23	207,665	18	91,475	.....	.....	221	3,963,741	19
South Dakota.....	16	321,620	3	31,000	3	324,300	4	84,650	.....	.....	8	118,710	.....
Tennessee.....	127	264,300	62	81,700	8	77,700	19	62,450	14	20,550	52	170,010	11
Texas.....	88	680,823	18	35,590	7	75,500	18	38,985	.....	.....	66	102,003	.....
Vermont.....	669	4,940,220	77	147,680	51	595,010	6	125,350	9	64,210	282	1,938,560	182
Virginia.....	58	203,886	25	31,087	.....	.....	.....	.....	.....	.....	20	137,163	3
Washington.....	8	35,300	.....	.....	.....	.....	.....	.....	.....	.....	36	355,805	29
West Virginia.....	94	815,479	15	155,055	5	18,000	5	4,500	.....	.....	114	464,062	2
Wisconsin.....	155	656,887	12	13,735	13	89,850	5	18,700	4	27,160	7	30,600	7
Wyoming.....	29	155,254	12	61,824	1	1,500	.....	.....	.....	.....	229	1,677,920	.....
MAJOR DRAINAGE BASINS.....	333	2,121,889	20	19,899	23	173,565	38	197,285	14	45,023	24	81,543	.....
Atlantic.....	40	120,793	4	17,360	6	19,000	3	800	.....	.....	.....	.....	.....
Chesapeake Bay.....	392	7,079,871	15	775,575	72	1,201,279	38	695,484	.....	.....	232	4,311,008	29
Delaware.....	631	16,993,198	53	567,380	48	1,112,192	39	3,396,630	2	15,800	40	1,564,000	70
Dismal Swamp.....	953	4,163,984	184	284,141	63	358,605	120	536,811	.....	.....	300	1,966,329	196
Florida.....	85	556,310	17	23,930	9	40,670	12	19,430	.....	.....	28	433,670	11
Georgia.....	599	5,534,724	34	137,534	34	741,125	40	336,365	.....	.....	441	4,099,370	29
Illinois.....	110	2,784,030	4	4,310	5	586,730	6	70,780	.....	.....	92	2,118,619	3
Indiana.....	125	1,065,321	145	161,219	123	1,883,857	109	421,370	13	41,190	644	7,538,035	50
Iowa.....	299	5,591,402	18	54,300	46	2,839,369	33	321,395	3	29,455	168	2,195,885	14
Kalamazoo River.....	867	2,497,667	167	198,979	96	535,864	116	795,144	6	76,230	41	827,825	3
Lower Mississippi.....	799	3,433,292	129	349,121	98	491,632	111	493,995	1	5,050	382	1,711,800	50
Michigan.....	116	2,784,030	4	4,310	5	586,730	6	70,780	.....	.....	92	2,118,619	3
Minnesota.....	125	1,065,321	145	161,219	123	1,883,857	109	421,370	13	41,190	644	7,538,035	50
Mississippi River.....	299	5,591,402	18	54,300	46	2,839,369	33	321,395	3	29,455	168	2,195,885	14
Missouri.....	867	2,497,667	167	198,979	96	535,864	116	795,144	6	76,230	41	827,825	3
Nebraska.....	799	3,433,292	129	349,121	98	491,632	111	493,995	1	5,050	382	1,711,800	50
Nevada.....	116	2,784,030	4	4,310	5	586,730	6	70,780	.....	.....	92	2,118,619	3
New England.....	125	1,065,321	145	161,219	123	1,883,857	109	421,370	13	41,190	644	7,538,035	50
New England Lakes.....	299	5,591,402	18	54,300	46	2,839,369	33	321,395	3	29,455	168	2,195,885	14
New England River.....	867	2,497,667	167	198,979	96	535,864	116	795,144	6	76,230	41	827,825	3
New England-Miss.....	799	3,433,292	129	349,121	98	491,632	111	493,995	1	5,050	382	1,711,800	50
Colorado River.....	154	691,554	40	82,840	46	680,550	50	122,530	.....	.....	32	409,373	5
Colorado River.....	628	4,870,665	72	186,570	46	680,550	50	122,530	.....	.....	281	1,971,810	165
Western Gulf.....	329	1,850,530	21	139,490	10	30,850	8	411,580	11	80,250	224	878,215	13
Pacific Northwest.....	10	149,736	23	194,790	13	4,599,778	24	358,855	1	2,000	22	1,258,098	38
California.....	104	332,818	20	53,247	5	17,900	14	41,709	7	19,237	46	193,018	12
Great Basin.....	7,518	76,443,731	973	3,101,636	608	15,315,936	753	7,687,048	41	598,110	329	40,897,694	921
Total.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,792	7,900,280	.....

TABLE 2. Reported needs for systems presently discharging raw sewage

	Total		New facilities		Connections to adequate treatment		No needs		No information	
	Number of facilities	Estimated population served	Number of facilities	Estimated population served	Number of facilities	Estimated population served	Number of facilities	Estimated population served	Number of facilities	Estimated population served
POPULATION SIZE GROUPS										
Under 500	294	93,914	237	77,325	2	400	21	6,220	34	9,769
500-1,000	552	352,220	1,072	307,153	6	3,470	22	16,735	34	31,720
1,000-5,000	1,377	2,388,116	1,872	2,397,158	5	8,470	55	119,135	122	147,663
5,000-10,000	315	1,732,910	269	1,510,743	7	43,530	14	78,007	36	100,530
10,000-25,000	210	2,712,660	171	2,290,330	9	63,480	9	122,100	21	238,750
25,000-50,000	74	2,091,107	55	1,696,607	3	13,700	9	238,800	7	142,000
50,000-100,000	38	2,144,290	28	1,672,093	1	13,200	1	33,000	8	366,000
Over 100,000	38	10,002,448	22	3,531,318	3	474,000	5	1,099,500	8	4,967,650
STATES										
Alabama	98	569,590	65	365,715			1	60	32	143,815
Arizona	7	21,850	4	14,600					3	7,250
Arkansas	32	246,840	13	30,400			8	195,600	11	20,240
California	41	241,463	30	163,723	2	8,630	1	2,360	13	66,400
Colorado	49	63,394	39	63,394					1	300
Connecticut	21	101,400	17	83,100	4	18,300			3	3,350
Delaware	10	14,650	7	11,300						
District of Columbia	35	394,895	25	334,609			2	34,500	8	25,715
Florida	68	321,850							68	321,850
Georgia										
Idaho	46	137,895	14	129,643					2	8,250
Illinois	48	375,905	48	375,905						
Indiana	154	388,930	140	363,138			4	6,400	2	21,400
Iowa	79	372,950	78	372,715					1	235
Kansas	36	242,020	34	228,420	1	13,200				400
Kentucky	53	126,525	50	125,643					3	800
Louisiana	35	938,423	5	38,350					3	5,000
Maine	149	453,601	144	448,641					5	4,900
Maryland	23	43,810	21	40,860	1	950			1	4,000
Massachusetts	58	1,064,130	41	527,250	11	505,050	3	21,150	3	10,000
Michigan	173	621,295	123	462,509	2	10,510	39	139,205	11	9,050
Minnesota	95	122,036	92	121,106			2	700	1	150
Mississippi	52	392,930	22	212,065			2	166,300	8	14,545
Missouri	71	1,376,286	58	691,446	1	29,000	2	7,600	10	257,540
Montana	28	182,120	28	182,120						

N. Dakota	90	373,375	87	373,005	2	870	1,500
Nebraska	57	9,116	6	8,116	1	1,500	1,500
New Hampshire	57	225,340	2	81,000	1	3,440	225,000
New Jersey	10	9,340	2	81,000	1	3,440	4,300
New Mexico	1	1,000					
New York	154	3,653,354	148	870,400	2	6,354	2,776,600
North Carolina	101	463,315	96	461,310	1		2,005
North Dakota	19	53,350	18	52,350	2	181,470	1,000
Ohio	1,044	996	139	706,616			184,910
Oklahoma	11	51,390	11	51,390			
Oregon	35	67,100	32	35,600	3	11,500	
Pennsylvania	3,093	567	617	1,978,850	5	12,650	1,096,017
Rhode Island	448	8	8	3,930			2,005
South Carolina	52	298,015	38	256,775	8	20,700	1,000
South Dakota	32	47,935	32	47,935			184,910
Tennessee	43	804,779	40	802,925	1	1,294	
Texas	13	100,750	18	71,600	1	310	650
Utah	18	299,425	16	375,495			18,840
Vermont	11	125,425	12	125,425	2	250	
Virginia	60	426,350	43	408,175	4	3,785	14,590
Washington	53	863,895	40	879,105	3	1,700	13,000
West Virginia	139	472,339	130	440,931	1	1,960	31,400
Wisconsin	21	86,275	19	83,335			980
Wyoming	29	67,838	29	67,838			
MAJOR DRAINAGE BASINS							
North Atlantic	485	2,660,951	482	1,965,711	17	523,600	250,390
North Pacific	343	4,650,995	300	1,795,985	3	21,150	2,825,920
North Atlantic	349	2,331,415	213	1,482,380	19	20,250	722,700
North Pacific	64	477,689	54	472,910	1	1,204	3,375
Tennessee River	626	3,963,711	589	2,501,702	3	157,884	1,399,885
Ohio River							
Lake Erie	67	146,433	66	144,463	1	1,970	856,320
Upper Mississippi	233	1,752,398	223	875,398	2	780	9,050
Lower Mississippi	195	680,926	142	350,201	4	141,470	5,285
Missouri River	165	1,431,111	254	1,431,111	2	1,195,383	29,405
Southwest-Lower Mississippi	165	1,431,111	93	680,323	53		
Colorado River	31	49,361	27	41,911			7,450
Western Gulf	17	108,655	10	79,815			18,840
Pacific Northwest	133	1,183,900	124	1,129,450	2	11,500	21,250
California	36	208,485	17	141,445	4	8,650	58,210
Great Basin	28	336,024	25	329,674	1	2,900	2,450
Total	3,040	21,917,665	2,549	13,503,984	36	630,660	6,111,639

No attempt was made to obtain any quantified need information other than the existence of a requirement and the tributary population. While dollar values can be estimated for certain categories of needs, the percentage application of per capita costs of new or replacement plants to other categories, such as plant enlargements or additions, would be a highly arbitrary procedure. Accordingly, dollar quantification of these sewage disposal needs was not attempted for the purpose of this report. The development of a defensible methodology is an absolute prerequisite to the preparation of such estimates, and will require considerable study.

The basic data are presented in tables 1 and 2, which show reported needs in two major categories: (1) For present treatment plants; and (2) for systems presently discharging raw sewage. The data are presented by population size groups, States, and major drainage basins. Further summarized data were prepared on needs by the various degrees of treatment, and by the various types of plants within the primary and secondary treatment classification. These tables have not been included as part of the basic data, but certain analytical tables are presented which were developed from them.

Needs of Present Treatment Facilities

Almost 6,600, 87.7 percent, of the 7,513 treatment plants in the United States reported on their status in regard to needs in 1957. These reports represented almost 90 percent of the population served by treatment. About 15 percent of the plants required replacement, 10.4 percent enlargement, and 11.4 percent require addition of other treatment units or processes. About 58 percent of the plants reporting indicated no current needs; these served almost 60 percent of the population served by present treatment facilities. The 14.8 percent of the plants reporting replacement necessary served only 4.5 percent of the population reported, while those plants needing enlargements represented 22.3 percent of the population.

Percentage distribution data for the various categories of needs within population groups, States, and major drainage basins for the class now having treatment are shown in table 3. In general, more replacements of present facilities are required in the smaller population groups, and more enlargements are required in the larger population groups. In group 8—over 100,000—more than one-fourth of the people connected to plants reporting needs are served by facilities that require enlargement. The percentage distribution for those facilities requiring addition of processes or units is remarkably constant among the various groups.

Among the States, wide variations are evident. In North Dakota and West Virginia over 50 percent of existing plants require replacement. Six States report that plants serving over 50 percent of the total population connected to treatment require enlargements, while three States and the District of Columbia report that plants serving more than 50 percent of the population require additions.

When the data are analyzed by drainage basins, variations in requirements are also wide. The Southeast and Colorado River basins report that approximately one-fourth of present treatment facilities require replacement, while in the Lake Erie basin only 3.7 percent of the plants serving only 0.2 percent of the population require replacement. The Northeast and North Atlantic basins report very small percentages of plants needing improved operation, while the Southeast, Tennessee River, and Colorado River basins report about 10 percent of plants requiring better operation.

Of considerable significance is the apparent reliability of the reported data, at least in regard to the percent reporting. These figures are shown in the last two columns of table 3. Nationally, 87.7 percent of the plants, serving 89.7 percent of the population served by treatment, reported needs data. By population groups, there was little variation in the degree of reporting. Some variation is noted among the drainage basins; however, only one, the California basin, where needs were reported for only 36.4 percent of the treatment facilities, deviated substantially. In the Missouri River basin reports were received for 99.7 percent of all treatment plants, serving 99.9 percent of the population. While there was considerable variation in reporting among the States, only three States reported needs for less than 69 percent of its plants, and one of these is faced with statutory requirements which limits its ability to report such data.

Needs of Raw Discharge Systems

In 1957 there were 3,048 separate raw discharge facilities serving 21.9 million persons. Based on reported needs, 93.6 percent, serving 85.5 percent of the population, require new plants. Surprisingly, 5.1 percent of the rawdischarges serving 10.6 percent of the population reported no requirements. Table 4 presents percentage distribution data for all classes of needs within community population groups, States, and major drainage basins.

Thirty-three States report that over 95 percent of the facilities and population now discharging raw sewage require new treatment plants. Arkansas and Louisiana are the only States reporting very large percentages of population with no requirements. In several States, substantial percentages of the population now discharging raw sewage require connection to an adequate system—presumably one incorporating treatment—for the solution of their problem.

In only two river basins is the percentage of population requiring no treatment facilities substantial. The Southwest-Lower Mississippi basin reports that 66.3 percent of the population now discharging raw sewage has no needs, and the Western Great Lakes basin reports 21.0 percent.

TABLE 3. Needs as stated by facilities having present treatment—percentage distribution of number of plants and population served

Percent of total reporting needing—																		
Total			Replacement of existing facilities		Enlargement		Addition		Chlorination		Improved operation		Connection to adequate system		No project needed		Percent of total reporting	
No. of plants	Est. pop. served		No. of plants	Est. pop. served	No. of plants	Est. pop. served	No. of plants	Est. pop. served	No. of plants	Est. pop. served	No. of plants	Est. pop. served	No. of plants	Est. pop. served	No. of plants	Est. pop. served	No. of plants	Est. pop. served
POPULATION SIZE GROUP																		
Under 500	100.0	100.0	14.7	13.8	4.9	5.6	12.8	11.4	0.9	2.0	8.6	7.5	0.2	0.2	57.8	59.5	85.1	79.9
500-1,000	100.0	100.0	18.4	17.0	6.6	6.3	13.8	13.3	0.9	0.9	7.4	7.0	0.2	0.3	52.7	55.2	90.6	91.4
1,000-5,000	100.0	100.0	37.8	34.8	10.9	11.8	10.5	8.9	0.3	0.3	4.9	4.8	0.3	0.2	55.3	59.2	86.9	86.9
5,000-10,000	100.0	100.0	8.6	6.8	12.3	14.3	10.4	13.0	0.9	1.2	2.9	2.9	0.6	0.3	65.0	61.3	89.5	89.6
10,000-25,000	100.0	100.0	5.5	3.8	15.8	16.9	10.8	11.0	3.0	1.5	1.5	0.9			63.4	56.9	89.4	89.4
25,000-50,000	100.0	100.0	6.3	5.3	16.0	15.9	13.1	12.7	0.6	0.7	3.4	2.7			60.6	61.7	87.4	88.4
50,000-100,000	100.0	100.0	5.7	5.3	23.0	27.0	12.5	12.2			1.1	3.2	1.1	0.1	54.6	52.2	88.9	88.5
Over 100,000	100.0	100.0	2.1	0.3	14.2	28.7	10.0	11.0	0.7	1.0			2.1	0.1	70.9	60.9	86.0	80.5
STATE																		
Alabama	100.0	100.0	18.1	4.6	3.8	1.4	41.9	50.8			4.8	3.0			31.4	40.2	87.5	98.2
Arizona	100.0	100.0	22.8	9.2	3.8	0.6	16.4	3.9	2.6	2.5	16.4	8.2			38.0	73.6	56.3	99.0
Arkansas	100.0	100.0	31.3	26.2	23.2	27.6					1.0	0.1			44.5	46.1	83.2	89.0
California	100.0	100.0	14.0	3.0	9.0	68.7	15.1	5.6	0.6	Neg.	5.6	3.3	0.6	Neg.	35.1	19.4	39.6	65.5
Colorado	100.0	100.0	21.7	3.2	7.3	16.2	38.0	64.0	9.4	8.5	0.9	0.1			25.5	8.0	96.1	99.9
Connecticut	100.0	100.0	1.6	1.6			6.2	5.7			1.5	0.2	1.5	0.1	80.0	78.2	98.5	99.5
Delaware	100.0	100.0	11.1	Neg.	11.1	0.5	33.3	7.8							44.5	91.7	100.0	100.0
District of Columbia	100.0	100.0					100.0	100.0			3.8	1.1	2.7	0.9	69.2	78.4	98.4	99.6
Florida	100.0	100.0	17.2	5.3	4.9	8.6	2.1	5.7							100.0	100.0	100.0	1.4
Georgia	100.0	100.0													100.0	100.0	1.3	1.4
Idaho	100.0	100.0	41.5	9.0	4.9	19.6	32.2	7.2			9.7	5.5			31.7	58.6	78.8	92.6
Illinois	100.0	100.0	7.4	8.8	12.6	5.8	4.5	3.8							75.5	89.6	100.0	100.0
Indiana	100.0	100.0	5.2	3.5	6.7	29.7	3.0	0.7			0.7	Neg.	0.7	Neg.	83.7	68.1	97.8	93.0
Iowa	100.0	100.0	22.3	5.6	10.9	51.4	10.9	4.9			9.1	2.5			46.8	33.6	99.3	100.0
Kansas	100.0	100.0	19.8	13.5	14.9	26.7	4.4	23.4			10.5	3.6	0.8	0.7	49.6	38.1	99.2	99.5
Kentucky	100.0	100.0	13.4	3.0	1.2	0.9	31.0	8.1			4.9	1.1	1.2	0.1	68.3	86.8	97.6	99.8
Louisiana	100.0	100.0	8.8	3.9	7.6	16.5	3.5	2.0							79.2	79.2	79.2	99.8
Maine	100.0	100.0	44.4	79.0			11.1	10.4			5.6	1.4			38.9	9.2	90.6	98.9
Maryland	100.0	100.0	14.6	5.5	20.8	77.8	4.2	0.4			12.5	0.8	2.1	0.6	45.8	14.7	92.3	97.0
Massachusetts	100.0	100.0	4.4	27.3	20.6	5.4	16.2	19.5							58.8	56.8	100.0	100.0
Michigan	100.0	100.0	8.8	1.4	25.8	73.2	10.3	2.9	0.7	0.7	1.9	1.7			48.5	39.1	94.4	95.8
Minnesota	100.0	100.0	16.2	2.1	9.8	70.2	14.9	4.1	0.4	Neg.	18.3	4.1			40.4	47.5	94.7	98.7
Mississippi	100.0	100.0	40.8	28.4	1.3	5.4	10.5	23.1							43.1	38.1	98.5	98.7
Missouri	100.0	100.0	11.1	16.9	15.1	20.0	3.1	9.6			7.3	2.4			56.5	30.1	95.3	99.3
Montana	100.0	100.0	31.7	26.6	12.2	15.1	4.9	24.9							2.2	1.3	100.0	100.0

Nebraska	100.0	100.0	11.0	7.9	9.8	28.9	2.6	1.2	15.8	3.7	59.8	54.2	100.0	100.0
Nevada	100.0	100.0	12.5	8.3	9.4	39.4	15.6	4.6	15.6	32.7	100.0	100.0	100.0	100.0
New Hampshire	100.0	100.0	10.9	6.7	6.8	1.6	5.7	27.3	0.5	0.1	100.0	100.0	100.0	100.0
New Jersey	100.0	100.0	14.5	13.1	11.6	23.5	5.8	2.8	1.4	Neg.	66.7	60.6	100.0	100.0
New Mexico	100.0	100.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	100.0	100.0
New York	100.0	100.0	2.7	1.5	20.0	8.1	8.2	11.2	0.3	Neg.	67.8	78.1	98.1	98.1
North Carolina	100.0	100.0	29.2	4.3	18.3	17.5	4.9	4.9	23.1	13.4	22.4	32.8	98.1	98.1
North Dakota	100.0	100.0	53.5	24.1	10.3	16.1	13.8	46.0	0.0	0.6	22.4	31.8	100.0	100.0
Ohio	100.0	100.0	2.8	0.3	3.1	12.5	7.3	5.6	0.4	0.1	86.3	81.6	97.3	99.8
Oklahoma	100.0	100.0	7.4	1.1	13.9	10.7	26.5	14.1	0.4	0.1	51.8	74.0	99.4	100.0
Oregon	100.0	100.0	9.5	2.5	3.4	2.0	3.4	1.3	48.8	1.7	79.4	44.7	99.1	99.6
Pennsylvania	100.0	100.0	2.0	0.1	8.3	4.9	6.6	2.1	0.4	Neg.	81.5	92.9	98.4	99.8
Rhode Island	100.0	100.0	39.2	18.9	18.1	18.7	32.0	13.7	0.0	5.0	30.0	22.1	104.0	100.0
South Carolina	100.0	100.0	39.2	18.9	18.1	18.7	32.0	13.7	0.0	5.0	30.0	22.1	104.0	100.0
South Dakota	100.0	100.0	7.9	5.7	5.5	30.3	31.5	23.6	3.1	1.9	52.3	38.5	104.0	100.0
Tennessee	100.0	100.0	20.7	5.3	8.1	11.2	20.7	5.8	10.3	9.8	40.2	67.9	98.4	99.4
Texas	100.0	100.0	15.8	5.2	10.5	20.8	13.8	5.1	1.4	0.5	57.5	67.8	72.8	87.9
Utah	100.0	100.0	46.4	14.2	14.2	16.4	11.9	11.9	1.8	0.3	36.4	71.6	94.8	93.9
Vermont	100.0	100.0	14.2	0.4	7.7	57.1	92.3	28.6	1.3	0.0	56.4	71.6	94.8	93.9
Virginia	100.0	100.0	23.1	28.9	7.7	7.7	7.7	0.8	1.5	0.5	60.0	66.4	69.1	65.7
Washington	100.0	100.0	7.8	2.1	8.5	13.7	3.3	2.9	2.6	4.2	74.5	70.0	98.7	99.6
West Virginia	100.0	100.0	54.6	64.2	4.5	1.6	9.1	2.4	2.1	0.3	21.8	31.8	75.9	82.0
Wisconsin	100.0	100.0	6.0	0.9	6.9	8.2	11.4	9.1	68.3	79.1	68.3	79.1	100.0	100.0
Wyoming	100.0	100.0	10.0	14.3	15.0	15.7	7.5	0.7	7.5	1.8	60.0	67.5	100.0	100.0
MAJOR DRAINAGE BASINS														
Northeast	100.0	100.0	4.1	11.1	19.8	17.2	10.5	10.0	0.8	Neg.	63.9	61.7	92.6	96.7
North Atlantic	100.0	100.0	24.3	8.5	6.3	10.7	15.9	14.6	0.1	Neg.	73.1	68.4	88.9	95.2
South Atlantic	100.0	100.0	23.0	4.4	12.2	7.5	16.2	3.6	10.8	4.7	37.0	79.8	87.3	97.2
Tennessee River	100.0	100.0	7.7	2.6	6.0	13.9	7.0	6.3	1.6	0.5	77.4	76.7	95.2	96.5
Ohio River	100.0	100.0	2.7	0.2	4.7	21.1	5.6	2.5	0.4	0.3	86.0	76.2	97.3	99.9
Lake Erie	100.0	100.0	13.1	1.6	11.1	18.6	9.9	4.1	0.4	0.3	58.2	74.4	95.7	99.7
Upper Mississippi	100.0	100.0	6.3	1.0	16.1	52.3	11.6	5.9	1.1	0.5	58.9	35.1	96.3	97.1
Western Great Lakes	100.0	100.0	12.3	8.0	11.1	11.3	12.4	21.9	0.7	0.7	47.4	32.9	93.7	99.9
Missouri River	100.0	100.0	17.4	11.2	13.3	13.8	13.0	13.8	2.6	0.4	51.6	33.0	92.6	96.7
Southwest-Lower Miss.	100.0	100.0	26.8	12.1	4.0	12.9	20.8	6.6	10.1	6.3	34.9	19.7	96.8	99.2
Colorado River	100.0	100.0	15.5	6.3	10.6	22.7	10.8	4.1	1.7	0.5	60.7	68.8	73.7	81.5
Western Gulf	100.0	100.0	12.3	3.0	6.6	8.7	3.2	2.0	2.5	3.3	70.9	55.3	94.0	99.3
Pacific Northwest	100.0	100.0	15.3	3.0	8.6	69.4	16.0	5.4	Neg.	4.0	54.7	19.0	36.4	65.3
California	100.0	100.0	21.7	16.9	5.3	5.9	15.2	13.7	7.6	6.3	50.0	63.2	88.5	91.7
Great Basin	100.0	100.0	14.8	4.5	10.4	22.3	11.4	11.2	5.0	1.3	57.5	59.7	87.7	89.7
Total	100.0	100.0	14.8	4.5	10.4	22.3	11.4	11.2	5.0	1.3	57.5	59.7	87.7	89.7

TABLE 4. Needs as stated by facilities with no present treatment—percentage distribution of number of plants and population served

	Percent of total reporting needing—									
	Total		New plants		Connections to adequate system		None		Percent of total reporting	
	Number of facilities	Estimated population served	Number of facilities	Estimated population served	Number of facilities	Estimated population served	Number of facilities	Estimated population served	Number of facilities	Estimated population served
POPULATION SIZE GROUPS										
Under 500	100.0	100.0	91.2	92.1	0.8	0.5	8.0	7.4	88.4	88.6
500-1,000	100.0	100.0	92.5	92.7	0.2	1.1	4.3	4.2	98.4	91.9
1,000-5,000	100.0	100.0	92.8	92.5	2.4	2.7	4.8	4.5	89.6	94.5
5,000-10,000	100.0	100.0	90.4	92.5	4.8	2.6	4.8	4.9	90.0	91.6
10,000-25,000	100.0	100.0	82.1	87.0	5.5	0.7	13.5	13.3	90.0	91.2
25,000-50,000	100.0	100.0	73.3	78.5	10.0	9.4	16.7	20.1	78.9	58.3
50,000-100,000	100.0	100.0								
Over 100,000	100.0	100.0								
STATES										
Alabama	100.0	100.0	98.5	100.0			1.5	None	67.3	71.8
Arizona	100.0	100.0	100.0	100.0					57.3	68.8
Arkansas	100.0	100.0	87.0	93.6	8.7	4.0	38.1	96.5	65.6	91.6
California	100.0	100.0	100.0	100.0				1.6	54.1	74.9
Colorado	100.0	100.0							97.5	99.7
Connecticut	100.0	100.0	81.0	82.0	19.0	18.0			100.0	100.0
Delaware	100.0	100.0							70.0	70.0
District of Columbia	100.0	100.0	95.6	90.7			7.4	9.3	77.1	77.1
Florida	100.0	100.0							0	0
Georgia	100.0	100.0	100.0	100.0					95.7	94.0
Idaho	100.0	100.0	97.4	98.8			2.6	1.2	100.0	100.0
Illinois	100.0	100.0	100.0	100.0					98.7	94.5
Indiana	100.0	100.0	97.1	94.5	2.9	5.5			98.7	99.9
Iowa	100.0	100.0	100.0	100.0					97.2	99.8
Kansas	100.0	100.0	100.0	100.0					94.3	99.3
Kentucky	100.0	100.0	100.0	100.0					91.4	99.3
Louisiana	100.0	100.0	100.0	100.0					96.6	94.9
Maine	100.0	100.0	92.5	97.7	4.5	2.3			98.7	91.3
Maryland	100.0	100.0	74.5	56.1	20.0	47.9	5.5	2.0	94.8	99.8
Massachusetts	100.0	100.0	75.0	75.6	1.2	1.7	23.8	23.7	93.7	98.5
Michigan	100.0	100.0	97.9	99.4			2.1	0.6	98.9	99.9
Minnesota	100.0	100.0	50.0	56.0			50.0	44.0	84.6	94.3
Mississippi	100.0	100.0	96.1	96.2	1.6	2.0	3.3	1.0	85.9	88.6
Missouri	100.0	100.0	100.0	100.0					100.0	100.0
Montana	100.0	100.0								

Extrapolated Data

Table 5 presents extrapolated data for the total number of plants and total population served by treatment based on the percentages developed for each category of need. The extrapolation of reported needs to all of the population and systems discharging raw sewage are shown in table 6.

Almost 4000 new plants to serve 22.2 million persons are needed now to replace existing plants and in systems presently discharging raw sewage. While most plants are required to serve systems discharging raw sewage at present, over 1,100 new plants to serve 3.4 million persons are required to replace existing plants. This is almost 15 percent of all treatment plants presently in existence in the United States.

In addition to the requirements for new plants, 779 plants serving 17.0 million persons require enlargement, and 851 plants serving 8.4 million persons need the addition of new units or processes.

The development of total needs from those reported was accomplished by assigning the unreported plants and population served to the various categories of needs on the basis of reported needs. This type of extrapolation produces data which vary slightly depending on the original data arrangement used. It was necessary, therefore, in producing uniform data to adopt one base set of reported data from which all extrapolated data would be developed.

Consequently, the smallest unit of tabulated data was used and the tables presented in this report were synthesized from these unit data. For primary and secondary treatment plants, the data unit used was the individual type of plant within each population group. The data unit for minor and intermediate treatment was the total within each population group. Even with such a procedure, it was necessary to make some minor data adjustments to present additive and comparable tables. While most of the extrapolated data tables present population data to the units digit, no false precision is intended. This was done because of the method of data handling. It is important to consider that the original data are "estimated population served," and that any statistical manipulation does not enhance the data validity.

Needs by Degree of Treatment

Extrapolated needs data for plants classified by degree of treatment are presented in table 7. Twenty-nine percent—795—of 2730 primary treatment plants require replacements; however, they serve only 5.2 percent of the population served by primary treatment. Only 6.5 percent of secondary plants require replacement. Enlargement of existing plants is a major need for all degrees of treatment. About 9 percent of the primary plants, 13.0 percent of intermediate plants, and 11.3 percent of secondary plants require enlargements. In the aggregate, these plants serve 17.0 million persons.

TABLE 5. Needs for facilities by present treatment plants¹

Need	Number of plants	Estimated population served—1,000's
Replacement.....	1,123	3,448
Enlargement.....	779	17,001
Additions.....	851	8,370
Chlorination.....	44	696
Improved operation.....	366	992
Connection to adequate system.....	24	66
None.....	4,331	45,871

¹ Extrapolated on basis of reported needs.TABLE 6. Needs for facilities by present raw discharge systems¹

Need	Number of systems	Estimated population served—1,000's
New plants.....	2,851	18,725
Connection to adequate system.....	40	861
None.....	157	2,332

¹ Extrapolated on basis of reported needs.

As might be expected, few secondary treatment plants require additions. However, almost one-fourth of the intermediate plants and one-fifth of the primary plants require new units or processes. About 70 percent of secondary plants, serving 31.3 million persons, have no requirements.

Primary Treatment Needs

A complete breakdown of extrapolated needs for various types of existing primary treatment plants is presented in table 8.

The majority, 61.5 percent, of present septic tank plants require replacement. These plants serve 62.5 percent of the population served by septic tanks. One in five present Imhoff tank plants requires replacement. These serve about 12 percent of the total population connected to Imhoff tank plants. Only 33—5.0 percent—of the mechanically cleaned tank type plants require replacement.

Almost one-third of the population served by mechanically cleaned tank plants is connected to one requiring enlargement, and over one-fourth of the population served by Imhoff tank plants is served by plants needing enlargement. Addition of other processes or units is required by almost 15 percent of the mechanically cleaned tank plants and by 28.3 percent of the Imhoff plants.

Secondary Plant Needs

Table 9 shows extrapolated need data for various types of secondary treatment plants. About 70 percent of the plants and population served have no requirements, yet quite significant needs exist in the remaining plants.

TABLE 7. Needs for facilities by present treatment plants¹—arranged by degree of treatment

Need	Minor		Primary		Intermediate		Secondary		Total	
	Number of plants	Estimated population served	Number of plants	Estimated population served	Number of plants	Estimated population served	Number of plants	Estimated population served	Number of plants	Estimated population served
Replacement	17	925,240	795	3,324,379	7	72,671	304	1,125,870	1,123	3,448,160
Enlargement	2	106,233	241	7,076,726	13	1,200,405	523	8,617,349	1,779	17,000,713
Additions	13	682,967	531	5,109,003	24	1,000,537	283	1,578,146	851	8,370,653
Chlorination	.....	.....	24	543,238	.....	.....	20	152,441	44	695,679
Improved operation	96	442,389	96	442,389	.....	.....	270	549,622	366	992,011
Connection to adequate system	.....	.....	6	15,927	.....	.....	18	49,238	24	67,165
None	9	145,890	1,037	11,135,083	56	3,317,339	3,229	31,252,436	4,331	45,870,750

¹ Extrapolated on basis of reported needs.TABLE 8. Needs for facilities by present primary treatment plants¹

Need	Septic tank plants		Inhoff tank plants		Mechanically cleaned tank plants		Plain settling tank plants		Others, unknown, and not rated		Total	
	Number of plants	Estimated population served	Number of plants	Estimated population served	Number of plants	Estimated population served	Number of plants	Estimated population served	Number of plants	Estimated population served	Number of plants	Estimated population served
Replacement	480	616,549	524	390,283	33	218,974	24	51,966	24	46,697	795	1,324,379
Enlargement	46	81,219	118	869,761	54	6,049,260	13	32,459	8	23,627	241	7,076,726
Additions	95	146,412	307	761,799	97	2,988,272	12	1,131,925	20	80,595	531	5,109,003
Chlorination	3	3,937	5	5,180	17	516,705	.....	.....	1	17,416	24	543,238
Improved operation	8	5,043	67	68,895	19	365,051	1	400	1	3,000	96	442,389
Connection to adequate system	3	7,446	3	8,431	.....	.....	.....	.....	.....	.....	6	15,927
None	145	125,935	352	1,241,663	436	8,408,154	30	137,235	76	1,172,076	1,037	11,135,083

¹ Extrapolated on basis of reported needs.

TABLE 9. Needs for facilities by present secondary treatment plants¹

Need	Activated sludge		Trickling filter—standard rate		Trickling filter—high rate		Sand filter		Land application		Oxidation ponds		Others and unknown		Total	
	No. of plants	Estimated population served	No. of plants	Estimated population served	No. of plants	Estimated population served	No. of plants	Estimated population served	No. of plants	Estimated population served	No. of plants	Estimated population served	No. of plants	Estimated population served		
Replacement	16	223,361	90	340,300	21	88,489	76	78,795	58	129,756	29	121,500	14	143,675	364	1,125,479
Enlargement	80	5,237,372	248	2,106,228	64	617,631	47	241,097	28	280,384	28	59,468	28	71,176	523	8,017,548
Additions	14	185,694	141	677,484	32	273,631	37	138,087	37	63,147	19	31,915	3	4,368	223	1,078,146
Chlorination	2	34,713	4	16,220	10	99,191	1	312	5	2,005	15	19,057	9	3,250	26	115,441
Improved operation	24	69,435	137	276,516	28	118,434	46	47,968	11	14,842	15	19,057	9	3,250	270	549,628
Connection to adequate system	3	6,792	3	22,247	6	10,613	1	1,072	2	305	3	305	3	7,899	18	49,389
None	459	18,796,363	1,247	5,910,966	651	4,754,982	186	322,845	201	505,959	339	528,001	155	433,419	2,229	31,252,408

¹ Extrapolated on basis of reported needs.

Over 5.2 million persons are served by 80 activated sludge plants that need enlargement, and 2.1 million persons are served by 248 standard-rate trickling filter plants that have similar requirements.

Almost 20 percent of the sand filter plants require replacement, as do 17.1 percent of the land application plants and 6.7 percent of the oxidation ponds. The oxidation ponds needing replacement serve 16.0 percent of the population served by such plants.

Discussion

While no attempt has been made in this report to place a dollar cost on these municipal sewage disposal needs, even a cursory examination reveals that considerable sums are involved. Though expenditures for new-plant construction show a decided increase from year to year (3), the rate must increase still more sharply if inroads are to be made in the large volume of immediate needs. As was pointed out in an earlier report (1), there has been an increase in the pollution load discharged to the streams of the United States since 1945. This has occurred even with a one-fifth reduction in the number of people discharging raw sewage, and an increase of 100 percent in the number of people served by secondary treatment.

It should be noted that the determinations of the needs reported in the Inventory were based on historic parameters of pollution. The needs, if any, that may develop as a result of more accurate characterization of some of the newer synthetic organics, are conjectural. However, in view of the burgeoning use of these products, both in the home and in industry, it can be assumed that the needs will be substantial. Rapidly developing uses of atomic energy for peaceful purposes could also contribute significant radioactive pollution unless adequate preventive measures are taken.

No comprehensive data are available to indicate the needs for industrial waste abatement measures where such wastes are not discharged to a community sewer system. The development of such data is a real and urgent requirement if official agencies are to adequately assess present programs for pollution abatement. Long-range planning is vital to the development of a sound program. Without a quantification of needs, including industrial waste control requirements, no such planning is possible.

The needs reported here represent only a portion of those necessary for satisfactory control of pollution. The development of parameters for measurement of the newer pollutants and the development of comprehensive data on independent industrial wastes discharges will add significantly to these requirements.

References:

- 1) THOMAN, JOHN R. and JENKINS, KENNETH H.: Statistical Summary of Sewage Works in the United States. PHS Publication No. 609 (1958).
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- 3) ABBOTT, W. H. and HUDSON, L. C.: Sewage Works Construction 1952-57, PHS Publication No. — *In Press*, (1958).